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SUBMISSION OF PRIORITY DOCUMENT

Attached please find the certified copy of the following foreign application from which priority is claimed for this case:

Country	Application Number	Filing Date
Great Britain	0107502.7	March 26, 2001

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Patents Act 1997
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Request for grant of a patent

(see the notes on the back of this form. You can also get an explanatory leaflet from the Patent office to help you fill in this form)

26 MAR 2001

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1	Your reference	UQI 50953
2	Patent application number *(The Patent Office will fill in this part)*	0107502.7
		~~26MAR01 E616877-2 D02877~~ P01/7700 0.00-0107502.7
3	Full name, address and postcode of the or of each applicant (underline all surnames)	Imperial Chemical Industries PLC Imperial Chemical House Millbank, London SW1P 3JF
	Patents ADP Number *(if you know it)*	935003
	If the applicant is a corporate body, give the country/state of its incorporation	United Kingdom
4	Title of the invention	Lubricant Compositions
5	Name of Your Agent *(if you have one)*	GRAHAM, John George
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	Uniqema Intellectual Property Dept PO Box 90, Wilton Middlesbrough Cleveland England, TS90 8JE
	Patents ADP Number *(if you know it)*	3942990 04
6	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and *(if you know it)* the or each application number	Country / Priority Application number *(if you know it)* / Date of Filing *(day / month / year)*
7	If this application is divided or otherwise derived from an earlier UK application, give the number and filing date of the earlier application	Number of earlier application / Date of Filing *(day / month / year)*
8	Is a statement of inventorship and of right to grant of a patent required in support of this request?	Yes

Answer yes if:
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See Note (d)

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Lubricant Compositions

The invention relates to lubricant compositions for use in gas compressors, especially sliding-vane rotary compressors.

It is n cessary to compress air and hydrocarbon gases either for direct use or for transport either in tanks or through pipelines in many applications. Such hydrocarbon gases include compressed natural gas, landfill gas, biogas, digester gas and wellhead gas. The compressors used in such applications, in having moving parts, require lubrication to reduce friction and wear and to provide, in some designs, a sealing effect. Many of the gases, depending upon their sources, contain significant quantities of impurities that can lead to aggressive environments within which the compressors have to work. For example, hydrocarbon gases frequently contain up to 20% of hydrogen sulphide and/or up to 50% carbon dioxide.

Compressors used to compress gases include screw, reciprocating, scroll and sliding-vane rotary compressors. Lubricants used to lubricate such compressors include mineral oils, white oil, poly α olefins (PAOs) and polyalkyleneglycols (PAGs). Although synthetic lubricants such as PAGs have been used successfully in screw and reciprocating compressors, their use in scroll and sliding vane rotary compressors have not been successful. This is probably due to the higher loads experienced in such compressors, especially sliding-vane rotary compressors in which high loads are experienced at the tips of the vanes and especially along the sides of the vanes as they reciprocate in their guide slots. These problems are exacerbated by acidic impurities in hydrocarbon gases causing corrosion.

In respect of sliding-vane rotary compressors, the lubricant has been typically a mineral oil. However, owing to dilution of the lubricant by the gas being compressed, especially in the case of hydrocarbon gases, the effectiveness of lubrication is limited and the compressor life is relatively short, e.g. 2000 hours. An alternative lubricant that has been used, but only with certain hydrocarbons, is a poly α olefin lubricant

It is an object of the present invention to provide a lubricant composition suitable for use in sliding-vane rotary compressors.

According to the present invention, a lubricant composition for use in a sliding-vane rotary vane compressor comprises:-

a) a polyalkyleneglycol base oil component, said polyalkyleneglycol comprising a random copolymer of ethylene oxide (EO) and propylene oxide (PO) having an EO:PO ratio between 3:1 and 1:3 and having been initiated with a compound having five carbon atoms or less;

b) 0.01% to 10% based on total weight of the composition of an antiwear additive;

c) 0.05% to 5% based on total weight the composition of an antioxidant;

d) 0% to 1% based on total weight the composition of a metal passivator;

e) 0% to 2% based on total weight the composition of an anticorrosion agent; and

f) 0% to 2% based on total weight the composition of a vapour phase anticorrosion agent.

clude gallates, imidazole, benzimidazole, pyrazole, benzotriazole, tolutriazole, tolutriazole, 2-methyl benzimidazole, 3,5-dimethyl pyrazole and methylene bis-benzotriazole.

Preferably, in the absence of other measures, such as material selection, to prevent corrosion, the lubricant composition comprises 0.1% to 2%, more especially 0.1% to 0.5%, based on total weight the composition of anashless anticorrosion additive. Example of suitable ashless anticorrosion additives includes amine napthalene sulphonates, amine phosphates, alkenyl succinic half ester and organic poycarboxylic acid. In particular ethylene diamine dinonylnapthalene sulphonate, diethylenetriamine dinonylnapthalene sulphonate andaliphatic amine salt of phosphoric acid monohexyl ester

Preferably, in the absence of other measures, such as material selection, to prevent corrosion, and particularly for gas applications that contain acidic impurities (sour gas) the lubricant composition comprises 0.05% to 2%, more especially 0.1% to 0.5%, based on total weight the composition of a vapour-phase anticorrosion additive. Although parts of the compressor are submerged under the lubricant composition, there are parts of the compressor and associated pipe-work etc that are exposed to the gases and any aggressive impurities they carry. Vapour-phase anticorrosion agents are volatilised from the lubricant composition at the operating temperatures of the compressor and coat other exposed surfaces to protect them from attack. Examples of suitable vapour-phase anticorrosion agents include silicones, siloxanes, silanes, silicates and volatile amines. In particular, Si-containing compounds include decamethycyclopentasiloxane, dimethylsiloxane pentamer, trimethylsilyl (2,6-di(trimethylsiloxy)phenyl) methanoate, triethoxy (3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl) silane and tetraethyl silicate; and volatile amines include primary amines, tripropylamine and ethyl-di-2-ethylhexylamine.

Lubricant compositions according to the invention may also comprise one or more other lubricant additives of known functionality at levels between 0.0001 and 20 %, more preferably between 0.01 and 10% more especially between 0.01 and 5%. Suitable additives include extreme pressure agents, acid scavengers, foaming agents, anti-foaming agents, stabilisers, surfactants, lubricity improvers or oiliness agents and friction modifiers.

According to another aspect of the invention, the use in a sliding-vane rotary vane compressor of a lubricant composition comprising:-

a) a polyalkyleneglycol base oil component, said polyalkyleneglycol comprising a random copolymer of ethylene oxide (EO) and propylene oxide (PO) having an EO:PO ratio between 3:1 and 1:3 and having been initiated with a compound having five carbon atoms or less;

b) 0.01% to 10% based on total weight of the composition of an antiwear additive;

c) 0.05% to 5% based on total weight the composition of an antioxidant;

d) 0% to 1% based on total weight the composition of a metal passivator;

e) 0% to 2% based on total weight the composition of an anticorrosion agent; and

c) 0. 5% to 2.5% based on total weight the composition of an antioxidant;

d) 0.1% to 0.5% based on total weight the composition of a metal passivator;

e) 0% to 2% based on total weight the composition of an anticorrosion additive; and

f) 0% to 0.5% based on total weight the composition of a vapour-phase anticorrosion additive.

Preferred lubricant compositions according to the invention consist essentially of said polyalkyleneglycol base oil component and additives.

Lubricant compositions according to the invention provide good lubrication in sliding-vane rotary compressors with a variety of gases. In particular, the polyalkyleneglycol has a relatively low solubility in the gases but has the ability to absorb water. The low gas solubility ensures, along with the specified additives, that there is sufficient lubricant composition present to lubricate the sliding vanes and their tips and to provide a seal at the vane tips between the high and low pressure sides of each vane.

As sliding-vane compressors may have significant down time, the ability of lubricant compositions according to the invention to absorb water that condenses from the gas as the compressor cools down as compared to any water remaining free in the compressor means that corrosion of metal components by the water is minimised or prevented. The efficacy of the lubricant composition is not affected by the absorbed water in that, following start up of the compressor, as it heats up to operating temperature the absorbed water volatilises out of the lubricant composition and is swept out of the compressor by the gas flow through.

Lubricant compositions according to the invention also have the advantage of working in compressors used for pumping hydrocarbon gases and air. Thus, it offers major logistical advantages in that compressor manufacturers only need stock one grade of lubricant avoiding issues of separate storage tanks for multiple grades, potentially filling compressors with the wrong lubricant etc.

The low cost of maintenance of sliding-vane compressors make them particularly useful in gas-boosting applications, particularly for micro-turbine applications.

A booster machine compresses air or gas from a pressure above atmospheric to a still higher pressure. Booster machines have many uses, especially in oil and gas fields and related industries. Examples of gas boosting are the feeding of wellhead gas to pipelines or of natural gas to gas turbines. In these latter applications, the compressor is used to supply gas at the flow rate and pressure needed for continuous operation of the turbine. Even small amounts of petroleum-based lubricants carried over in the gas to the turbine may produce carbonaceous deposits in the gas inlet nozzles of the turbine restricting flow and causing flameout. The low carry over, high thermal stability and clean burning capabilities of lubricant compositions according to the invention make them particularly suited for this role. In such applications, the compression of the gas may be either single- or multistage, depending upon the pressure differentials, horsepower, and the analysis of the gas.

The invention will now be described further by way of example only with reference to the accompanying drawings and the following Examples.

		additive consisting of polymerised 1,2-dihydro-2,2,4-trimetylquinoline
	0.5%	3,5-dibutyl-4-hydroxytoluene, an antioxidant.
0.5%		Ethanox 702 available from Albemarle, an antioxidant additive consisting essentially of 4,4'-methylene-bis(1,1-dimethyl-ethyl)-phenol

All % shown in the table are weight % based on the total composition.

Sample 1 has the properties shown in Table 2.

Table 2

Properties	Test	Sample 1	Sample 2
Viscosity (cSt) at 40°C	ASTM D-445	83.3	82-84
Viscosity (cSt) at 100°C	ASTM D-445	16.0	
Viscosity Index	ASTM D-2270	206	
Pour Point (°C)	ASTM D-97	-38	
Flash Point C)C (°C)	ASTM D-92	261	
Acid Value (mgKOH/g)	ASTM D-974	0.33	
Copper Corrosion	ASTM D-130/94	Pass – 1A	
Steel Corrosion	ASTM D-665A	Pass – No corrosion	
4 Ball Wear Scar (mm)	ASTM D-2783	0.73	

Example 2

The effect of a hydrocarbon, eg heptane, on the viscosity of Sample 1 and of comparative samples, namely Sample 3 – a commercially available mineral oil formulation used in sliding-vane rotary compressors – and Sample 4 – a commercially available phthalate ester formulation used in sliding-vane rotary compressors – was tested. The test was done by first measuring the viscosity of the neat samples. Then the viscosity of the samples following exposure to heptane was measured. The samples were exposed to heptane by pouring 40mls of the sample into a measuring cylinder and adding 4mls, ie 10%, of heptane into the cylinder. The sample and the heptane were stirred together for 5 minutes and then left to separate for one hour. The heptane layer that separated from the sample was then removed and the viscosity of the sample determined. The test was repeated with fresh quantities of the samples and added amounts of heptane at levels of 8mls, ie 20%, 12mls, ie 30%, and 16mls, i.e. 40%.

The viscosity of each of the tested samples was measured using the ASTM D445 method at 40°C.

The results are shown in Table 3 and are shown in graphical form in Figure 2. As can be seen, the viscosity of Sample 1 remains significantly higher at high hydrocarbon loading as compared to the viscosity of the commercially-available Samples 3 and 4 and, consequently, the lubricity effect of Sample 1 will be higher than that of Samples 3 and 4 under those high loading conditions.

Table 3

After the test duration, the samples were tested for kinematic viscosity @ 40 °C and Acid Value (Neutralisation number) and were then compared to the initially-measured values of those parameters for evaluation of the performance of the lubricant compositions. The acid value measurement was a combination of acid values of both the Samples 1 and 4 and the respective water samples associated therewith to allow for the fact that low molecular weight acid from the decomposition of the lubricant compositions were volatilised from the Samples 1 and 4.

The results are shown in

Table 5

Lubricant	Sample 1	Sample 4
Viscosity at 40°C In cSt	79.3	100.8
%Change in viscosity at end of test	0.9	4.2
Initial Acid Value in mgKOH/g	0.32	0.09
Change in Acid Value in mgKOH/g	0.02	0.49

Sample 1 has a much lower change in viscosity and acid value as compared to Sample 4

c) 0.05% to 5% based on total weight the composition of an antioxidant;

d) 0% to 1% based on total weight the composition of a metal passivator;

e) 0% to 2% based on total weight the composition of an anticorrosion ag nt; and

f) 0% to 2% based on total weight the composition of a vapour phase anticorrosion agent.

4. A sliding-vane rotary compressor charged with a lubricant composition comprising:-

a) a polyalkyleneglycol base oil component, said polyalkyleneglycol comprising a random copolymer of ethylene oxide (EO) and propylene oxide (PO) having an EO:PO ratio between 3:1 and 1:3 and having been initiated with a compound having five carbon atoms or less;

b) 0.01% to 10% based on total weight of the composition of an antiwear additive;

c) 0.05% to 5% based on total weight the composition of an antioxidant;

d) 0% to 1% based on total weight the composition of a metal passivator;

e) 0% to 2% based on total weight the composition of an anticorrosion agent; and

f) 0% to 2% based on total weight the composition of a vapour phase anticorrosion agent.

5. A lubricant composition for use in a sliding-vane rotary vane compressor comprising:-

a) a polyalkyleneglycol base oil component, said polyalkyleneglycol comprising a random copolymer of ethylene oxide (EO) and propylene oxide (PO) having an EO:PO ratio between 1.5:1 and 1:1.5 and having been initiated by methanol or butanol and having a kinematic viscosity of at least 12 cSt at 100°C;

b) 0.01% to 10% based on total weight of the composition of an antiwear additive;

c) 0.05% to 5% based on total weight the composition of an antioxidant;

d) 0.1% to 1% based on total weight the composition of a metal passivator;

e) 0% to 2% based on total weight the composition of an anticorrosion agent; and

f) 0% to 2% based on total weight the composition of a vapour phase anticorrosion agent.

Figure 1

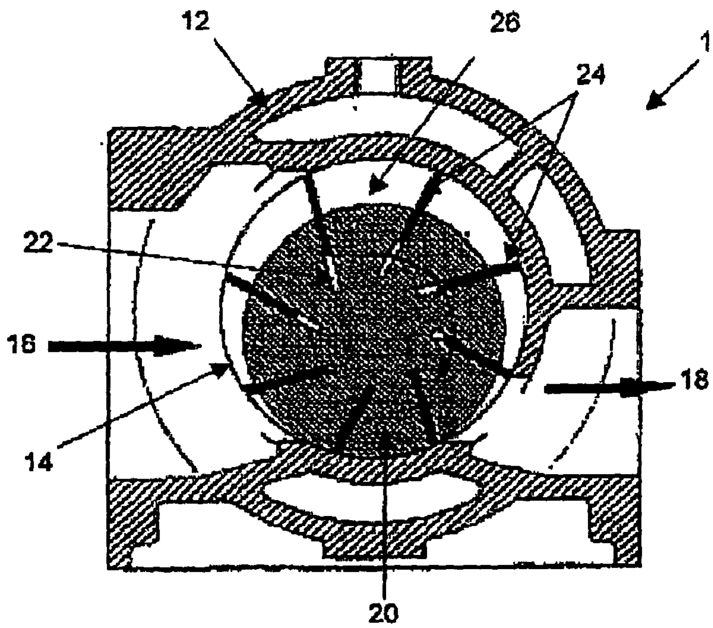
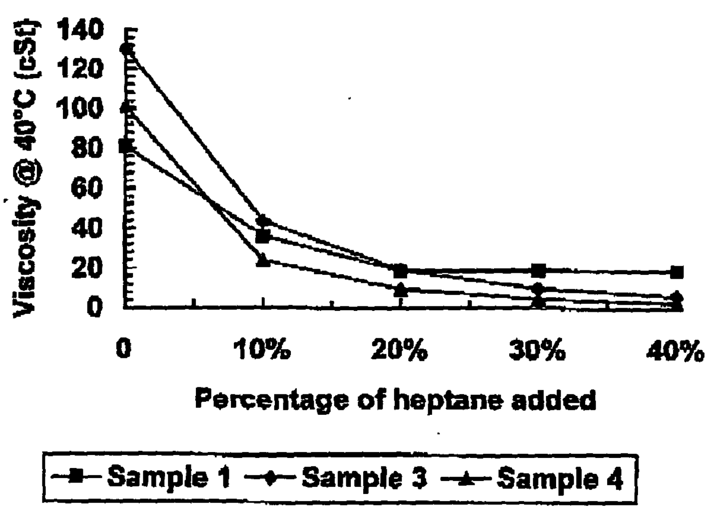


Figure 2



Applicant's Reference UQI 50953

Figure 3